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WINForum Spectrum Etiquette

for

Unlicensed PCS Devices

GEN Docket No. 90-314
ET Docket No. 92-100

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WIRELESS INFORMATION NETWORKS FORUM

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Introduction to the WINForum Spectrum Etiquette

The Wireless Information Networks Forum (WINForum), on behalf of the unlicensed Personal Communications Services industry, hereby submits for comment its suggested Spectrum Etiquette for coexistence of unlicensed PCS devices under consideration by the Commission in General Docket 90-314.

The Etiquette is a means for widely differing applications and devices to gain fair access to the same spectrum. It is intended to foster technical advances and support applications including computer local area networks (LANs) and wireless private branch exchanges (PBXs), as well as other projected concepts. The Etiquette provides simple rules that work as follows to enable the coexistence of a wide range of cost-effective, spectrum-efficient unlicensed digital radio devices.

Function of the Etiquette

A device may not transmit if the spectrum it will occupy is already in use within its range; this function is called listen-before-talk (LBT). To provide fair spectrum access to many users, a current user's transmit duration is limited to short bursts or repetitions of 1/100 second after which the spectrum is available to other users.

Transmit power is limited to keep range short, so that spectrum can be reused in buildings with densely populated offices, meeting rooms and school facilities. Permitted power is also related to bandwidth so as to equalize mutual interaction among narrow- and wide-band users. Under the Etiquette, use of minimum power is encouraged by a dynamic listen-before-talk threshold.

Envisioned are both voice services (generally requiring continuous connection-oriented, isochronous operation) and data services (bursty, connectionless, asynchronous). Because the two service types are technically contrasting, separate sub-bands are required, along with crossover rules to avoid wasting unused spectrum.

Isochronous applications such as voice are permitted to complete a continuous conversation without dropping the connection. Bandwidth in the asynchronous sub-band may range from 50 kHz to 10 MHz, while the isochronous sub-band is divided into 1.25 MHz segments that can also contain narrower-band signals.

Development of the Spectrum Etiquette

WINForum first met formally in July 1992, with participation from large and small computer and communications companies. Its technical committee was established then. From July to December 1992, the committee met twice monthly, with typical attendance of twenty to forty professionals. By that time, the committee had spawned several working groups specializing in data, voice and crossover rules. As these working groups met even more often by telephone and electronic conferencing, full committee meetings were then scheduled monthly through June 1993. A favorable vote of two-thirds of the attendees is required to establish the consensus content of the Etiquette.

The concept that a set of rules might support fair coexistence of many different types of devices was advanced by AT&T. Initially, it was anticipated that a single Etiquette might cover both voice and data applications. However, after substantial effort and numerous technical papers, it was seen with some disappointment that the key requirements for data centered on discontinuous bursts of high-rate data with low overhead and transmission delay, while for voice the key requirement was continuity, dictated by freedom from call dropping.

At this stage in late 1992, it was determined to work toward separate sub-bands and Etiquette provisions for isochronous and asynchronous modes, with the hope that the completed efforts would reveal areas of convergence that would enable coexistence of both modes in the same spectrum.

Despite substantial efforts during the first four months of 1993, the contrasting requirements of isochronous and asynchronous modes have not been melded. Instead, a set of rules is being developed defining conditions under which one mode may cross over into the other mode's sub-band if sufficient spectrum is free of use. It is felt by many that the crossover rules can only be effective in geographic areas of light overall usage, and the difficulty of this effort highlights the need for adequate spectrum to support both modes in areas of high occupancy.

The technical committee work has consumed an estimated 100,000 hours of professional effort, and several hundred internal technical papers have been generated in support of the work. The Etiquette is in its fourteenth revision, and there remain two issues still being resolved. The crossover rules are being analyzed and edited, and

a proposal has been advanced to modify substantially the operation of the listen-before-talk protocol in the isochronous sub-band.

Both modern cordless telephony and data networking have provided major breakthroughs in technologies that permit unlicensed operation of independent devices with high tolerance to interference. These new technologies, particularly packet techniques and protocols, underlie the opportunity to provide unlicensed yet coexisting personal radio devices for data and voice. The WINForum Spectrum Etiquette sets out rules that will lead to realization of these ground-breaking concepts.

WINForum offers this work in progress with the expectation that constructive criticism will further improve its content and phrasing, and that it will form the basis of equipment authorization rules for devices operating in the spectrum allocated to unlicensed PCS devices.

WINForum Spectrum Etiquette for Unlicensed PCS Devices

1.0 INTRODUCTION

1.1 Transmitters in this band shall be used only for digitally modulated transmission, and shall be limited by power, bandwidth, transmission time, and channel access mechanism so as to provide fair access and coexistence for short range systems.

1.2 Definitions

1.2.1 Isochronous Transmitters shall be defined as transmitters that emit at regular intervals, as typified by Time-Division voice systems.

1.2.2 Asynchronous Transmitters shall be defined as transmitters that emit at irregular intervals, as typified by Local Area Network (LAN) data systems.

1.2.3 The transmit power "P" is the maximum of the mean radiated power over any interval of continuous transmission.

2.0 TRANSMIT POWER LIMITS

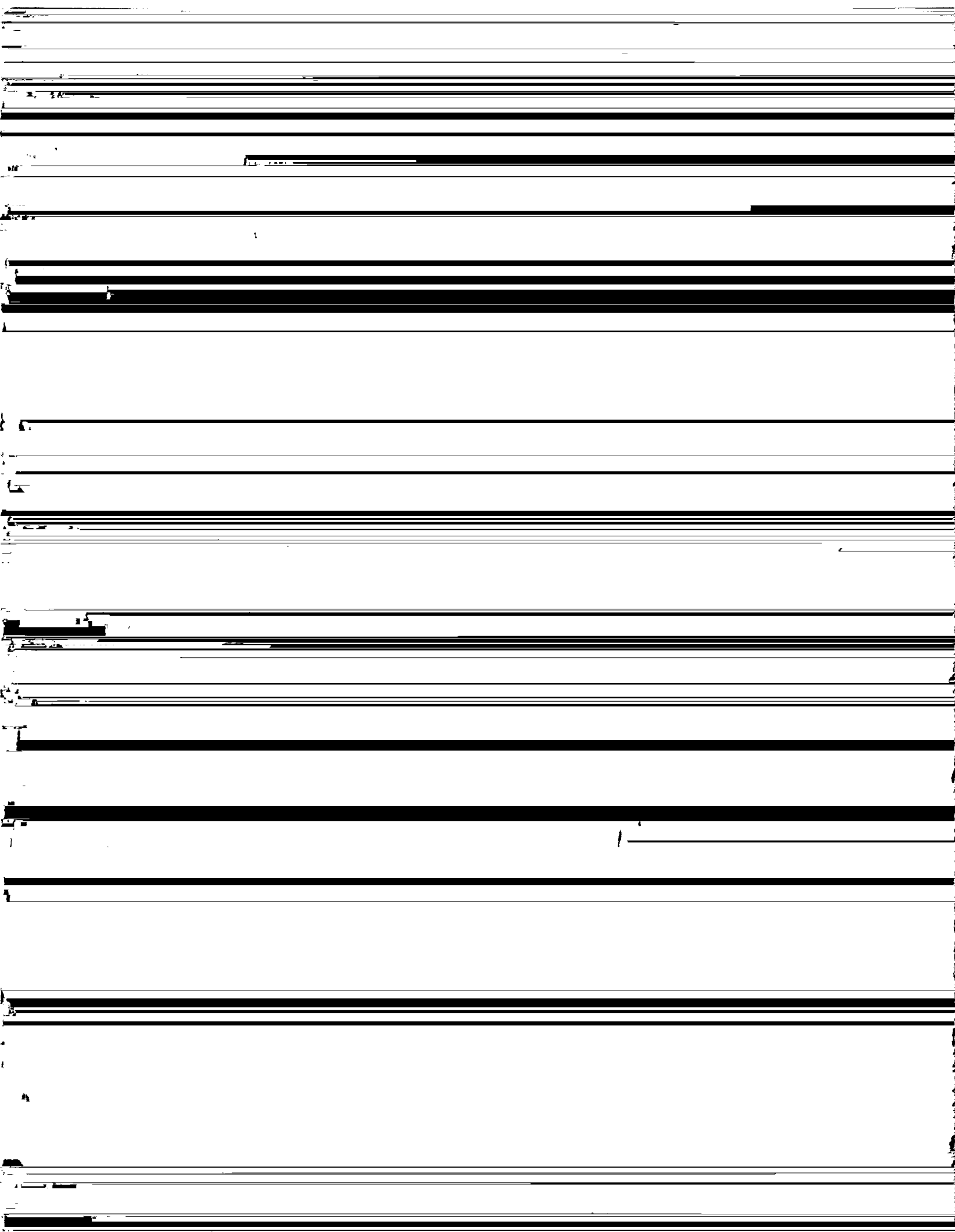
2.1 Maximum Transmit Power

2.1.1 The transmit power P shall not exceed 1.0 E-4 * sqrt(B) Watts, where B = occupied bandwidth in Hz.

2.1.2 Further the transmit power shall not exceed 3 E-3 Watts in any 3-kHz-wide band at any time.

2.1.3 Power-Bandwidth Example Table

Power, mW	Bandwidth, MHz
32	0.1
52	0.3
100	1.0
173	3.0
316	10.0



3.6 Spectrum Sharing

3.6.1 Isochronous Device Use of Asynchronous Spectrum

[Note: This section is under analysis/review, and is not final. Rules regarding crossover from the isochronous to the asynchronous sub-band have been proposed and are under active analysis and consideration.]

3.6.2 Asynchronous Device Use of Isochronous Spectrum

[Note: This section is under analysis/review, and is not final. Rules regarding crossover from the asynchronous to the isochronous sub-band have been proposed and are under active analysis and consideration.]

3.7 Frequency Stability:

3.7.1 In the asynchronous sub-band, the stability of the frequency-determining elements in the transmitter shall be equal to or better than +/- 10 ppm over 10 milliseconds or the interval between LBT monitorings, whichever is shorter.

3.7.2 In the isochronous sub-band, the stability of the frequency-determining elements in the transmitter shall be equal to or better than +/- 10 ppm over 1 hour or the interval between LBT monitorings, whichever is shorter.

5.0 CHANNEL ACCESS

5.1 Channel Access in the Isochronous Sub-band

5.1.1 All transmitters operating wholly or partly within the isochronous sub-band shall monitor the intended occupied bandwidth for at least 10 milliseconds before transmitting the first packet or packet burst in any single sequence.

5.1.2 Succeeding transmissions may be sent without further monitoring, as long as the occupied bandwidth is entirely within the isochronous sub-band.

5.2 Channel Access in the Asynchronous Sub-band

5.2.1 Before each burst is transmitted, transmitters operating entirely or partly within the asynchronous sub-band shall monitor the intended occupied bandwidth for a period that is at least the longer of 30 microseconds or 20 times the inverse of the occupied bandwidth.

5.2.2 Once a burst has started, participating transmitters are not required to monitor the channel, providing the gap between each transmissions does not exceed the intra-burst gap 4.2.1.

5.3 Channel Access Criteria and Selection

5.3.1 If either of the mechanisms described above indicates that the particular frequency selected is in use, transmission may not proceed; there are two possible channel access alternatives.

5.3.1.1 Another frequency may be selected and monitored.

5.3.1.2 After the channel becomes idle, the transmitter shall wait a deference time chosen from a uniform random distribution between X and 15X, where X = 10 milliseconds for isochronous systems; X = 50 microseconds for asynchronous systems. At the end of this period, the transmitter may again proceed according to the appropriate rule 5.1 or 5.2.

240X milliseconds is reached. The range is reinitialized after each successful access attempt.

5.3.3 Each transmitter shall implement a channel access mechanism adequate to prevent catastrophic congestion.

5.4 Monitoring Requirements

5.4.1 The monitoring mechanism shall operate via the transmitting antenna, or one that includes the coverage area of the transmitting antenna.

5.4.2 It shall have a threshold that is within [24] dB of the thermal noise power in the occupied bandwidth. [Note: A substantial increase in this level has been proposed for the isochronous sub-band and is under active analysis and consideration.]

5.4.3 Maximum Reaction Time

5.4.3.1 For asynchronous transmitters, the maximum reaction time of the monitoring system will be 50 microseconds for signals at the threshold level 5.4.2 and